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Investigation of structural, electrical and dielectric properties of sol-gel prepared $\text{La}_{0.67-x}\text{Eu}_x\text{Ba}_{0.33}\text{Mn}_{0.85}\text{Fe}_{0.15}\text{O}_3$ ($x=0.0, 0.1$) manganites

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Investigation of structural, electrical and dielectric properties of sol-gel prepared $\text{La}_{0.67-x}\text{Eu}_x\text{Ba}_{0.33}\text{Mn}_{0.85}\text{Fe}_{0.15}\text{O}_3$ ($x=0.0, 0.1$) manganites

W. Ncib^a, A. Ben Jazia Kharrat^{a,*}, M. A. Wederni^b, N. Chniba-Boudjada^{a,c}, K. Khirouni^d, W. Boujelben^a

^aLaboratoire de Physique des Matériaux, Faculté des Sciences de Sfax, Université de Sfax, B. P 1171, 3000 Sfax, Tunisia.

^bUnité de Recherche Matériaux Avancés et Nanotechnologies (URMAN), Institut Supérieur des Sciences Appliquées et de Technologie de Kasserine, Kairouan University, BP 471, Kasserine 1200, Tunisia.

^cInstitut Néel, B.P. 166, 38042 Grenoble Cedex 9, France.

^dLaboratoire de Physique des Matériaux et des Nanomatériaux appliquée à l'Environnement, Faculté des Sciences de Gabès, Université de Gabès, cité Erriadh, 6079 Gabès, Tunisia

Abstract

Polycrystalline samples of $\text{La}_{0.67-x}\text{Eu}_x\text{Ba}_{0.33}\text{Mn}_{0.85}\text{Fe}_{0.15}\text{O}_3$ ($x=0.0, 0.1$) manganites have been prepared using sol-gel route. Structural characterizations of our materials were performed by powder X-ray diffraction, Scanning Electron Microscopy and by Energy Dispersive X-ray spectroscopy at room temperature. Our samples are single phase and crystallize in the orthorhombic structure with the Pbnm space group. Electrical and dielectric properties of $\text{La}_{0.67-x}\text{Eu}_x\text{Ba}_{0.33}\text{Mn}_{0.85}\text{Fe}_{0.15}\text{O}_3$ ($x=0.0, 0.1$) compounds have been studied using impedance spectroscopy technique in the temperature range from 80 to 400 K and the frequency range from 40 to 10^7 Hz. DC measurements show that the studied structures exhibit semiconductor (SC) behavior in all temperature range of study. AC data analysis show a transition from SC to metallic behavior at $160 < T_{SM} < 170\text{K}$ and $220 < T_{SM} < 240\text{K}$ for $x=0$ and 0.1 respectively. In the SC region, the conductivity σ_{AC} obeys to Jonscher power law at low temperatures while at high temperatures, the classical Drude model describes well the frequency dependence of the conductivity data. Nyquist plots allow us to propose an equivalent circuit involving the contribution of grains and grain boundary elements. Dielectric measurements show that the dielectric relaxation is governed by the DC conduction process. Dielectric results confirm the high values of the permittivity which approve the use of manganites in electronic applications. Besides, the relaxation process in the dielectric spectra is shown to be totally obscured by the DC-conductivity.

Keywords: Sol-gel; Europium substitution; Impedance spectroscopy; Electrical properties; Dielectric properties.

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